Changes in the optimal tax rate in South Africa prior and subsequent to the global recession period

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CHANGES IN THE OPTIMAL TAX RATE IN SOUTH AFRICA PRIOR AND SUBSEQUENT TO THE GLOBAL RECESSION PERIOD

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ABSTRACT: Following the global recession period of 2009, much debate has been cast on the role of tax policy in improving economic growth in the South African economy. In our paper, we estimate optimal tax rates for South Africa using the optimization model of Scully (1996, 2003) applied to quarterly data collected for periods before the crisis (i.e. 1994:Q1 – 2009:Q2) and for periods after the crisis (2009:Q2 – 2016:Q2). We estimate our optimization model using the autoregressive distributive lag (ARDL) bounds test approach. Our empirical estimates reveal an insignificant relationship between taxation and economic growth for periods prior to the global recession period whereas we find a significant relationship for periods subsequent to the recession, with an optimal rate of tax being found to be 22 percent of GDP. These empirical results highlight that whilst tax policy had an insignificance effect on economic growth in South Africa before the recession of 2009, tax policy appears to play an important role in promoting short-run and long-run economic growth in the post-recession era. Furthermore, our results suggest that fiscal authorities should ensure that tax revenue as a share of GDP should do not exceed the optimal rate of 22 percent in the interest of attaining higher rates of economic growth.

Keywords: Tax; Economic growth; Fiscal Policy; Optimal tax rate; Optimal government size; South Africa; Sub-prime crisis; Global recession.

JEL Classification Code: C13, C32, C52, E62, H21, O40.

1 Introduction

The sub-prime crisis in the United States which led to the bankruptcy filing of the Lehman brothers in September 2008, sparked a worldwide financial crisis which has been labelled as the worst financial crisis since the Great Depression. The subsequent global recession period of 2009 forced most governments worldwide to increase government expenditure in order to boost economic growth recovery. However, many governments have not been able to raise enough revenue in order meet their demanding expenditure obligations and this has led to many economies acquiring large fiscal deficits. Euro countries can be referenced as an extreme case of such circumstances where excessive accumulation of debt levels eventually led to the European sovereign debt crisis of 2009. For the case of Africa, lingering budget deficits and poor fiscal management have been typical of governments since the 1980's and South Africa is one of the few African countries which managed to attain a budget surplus in the post-2000 period. In particular, South African fiscal authorities maintained a budget surplus of 0.6 and 1 percent of GDP in the consecutive fiscal years of 2005/2006 and 2006/2007, respectively. However, the budget has fallen back to a deficit in the post-recession period averaging 4.8 percent of GDP between 2010-2015 and this has resulted in government dramatically increasing it's debt levels from 34.7 percent of GDP in 2010 to 50.1 percent of GDP in 2015. Recently, the Davies Tax Committee (DTC) was formed and placed in charge of assessing South Africa's tax policy in the post-recession period. Part of the committee's mandate involves assessing the role in which tax policy supports important macroeconomic goals such as improved economic growth. It is therefore important for the committee to know how to maximize economic growth through the collection of taxation as a form of government revenue. It thus follows that the Committee's main empirical interest should be with finding an optimal tax rate that would maximize economic growth gains or similarly minimize growth losses.

The notion of an optimal tax rate has it's theoretical roots embedded in the works of Laffer (1981) who hypothesized on government size being positively correlated with economic growth up to a certain critical point of which this relationship then turns adverse. Since then there has emerged a number of theoretical models which have hypothesized on a similar inverted U-shaped relationship between government size and economic growth and collectively these models are referred to as the BARS curve in commemoration of Barro (1990), Armey (1995), Rahn and Fox (1996) and Scully (1995, 1996, 2000, 2003). However,

it was Scully (1995, 1996, 2000, 2003) who, in a series of papers, rationalized an empirical method of extracting a point estimate of the optimal tax rate which maximizes economic growth. A number of studies have followed in pursuit by applying Scully (1995, 1996, 2000, 2003) framework to variety of industrialized and developing economies (see Chao and Grubel (1998) for Canada, Hill (2008) for the US, Keho (2010) for Ivory Coast and Forte and Magazzino (2011) for 27 EU countries). In addition to this list, there are two other empirical studies which have used Scully's framework to estimate optimal tax rates for South African data. On one hand, Schoeman and van Heerden (2009) use non parametric estimation techniques and conventional cointegration analysis to obtain an optimal tax rate of 18 percent for South Africa using data collected from 1960 to 2009. On the other hand, Saibu (2015) uses linear and nonlinear transformations of Scully's framework to estimate an optimal tax rate of 15 percent for South African data collected over the period of 1964 and 2012. Apart from the issue of differences in methodological approaches, another possible cause for the discrepancies in empirical results can be attributed to the time periods used in both studies. Whilst the study of Schoeman and van Heerden (2009) strictly employs data collected prior to global recessionary period, Saibu's (2015) study uses data which partially covers the post-recessionary era. Based on this observation there would be very little reason to doubt that the dynamics of the optimal tax-growth relationship in South Africa have possibly changed from the pre-recession period to the post-recession period.

In our study we complement the studies of Schoeman and van Heerden (2009) and Saibu (2015) by applying Scully's tax-optimizing framework to two datasets, those being, one for the pre-recessionary period of 1994 to 2009 and the other for the post-recessionary period of 2009 to 2016. Note that the first sub-period relates to a period in which the Katz Commission was in charge of tax policy in South Africa throughout the post-Apartheid period up until the global recession period. The second sub-period is largely representative of tax policy under the Davies Tax Committee whose primary mandate centres on eradicating the adverse effects of the global recessionary period. Therefore, as a by-product of our empirical strategy we avoid any spurious regression problems that would arise from possible structural breaks associated with the recessionary period of 2009 and the shift in tax committees. Our choice of empirical framework for this study is the autoregressive distributive lag (ARDL) model of Pesaran et. al. (2001) and this model presents a number of advantages over other competing cointegration frameworks. Firstly, the ARDL framework is well known for it's ability to yield consistent long run regression coefficients and model asymptotically normal cointegration relations

between a combination of I(0) and I(1) variables. Secondly, the model can perform quite well even with small samples which is a feature which will prove to be particularly useful when conducting our cointegration analysis on the smaller data associated with the second sub-period. Lastly, both short-run and long-run coefficients of the ARDL model are estimated simultaneously without the loss of any long-run information.

Having provided the background to the study, the rest of the manuscript is structured as follows. The next section of the paper provides an overview of developments in the South African tax system in South Africa. The third section of the paper provides a historical overview of tax policy in South Africa. The fourth section of the paper presents both the theoretical and empirical models used in the paper. The empirical data and estimation results are given in the fifth section of the paper whereas the paper is concluded in the sixth section of the paper in the form of policy implications and suggestions for future research.

2 A historical overview of tax policy in South Africa

Prior to South Africa's first democratic elections in 1994, tax policy was designated under the authority of two tax commissions. The first was the Franszen Commission of 1970 and this was later replaced by the Margo Commission in 1987. The Franszen Commission was established by the former Apartheid government with the purpose of inquiring into the South African tax and financial systems and also proposing recommendations regarding modifications to these systems which would promote economic growth. At the time government revenue collected was largely deployed on military spending in the interest of domestic security amidst heightened political unrest. The Franszen Commission raised concerns of the structure of South African tax system and warned of the dangers of increasing the already high personal tax burden. In particular the commission found that too much reliance was placed on raising revenue through direct taxes such that the share of direct taxation as a proportion of total tax revenue was significantly higher when compared to other industrialized economies (Schattil, 1969). Hence, the recommendations of the commission involved widening the indirect tax base as an avenue for increased tax collection. One of the major reforms undertaken by the commission involved replacing the sales duties with a 4 percent general sales tax (GST) and this resulted in a reduction in marginal personal income tax (Koch et. al., 2005). The Franszen Commission further recommended a shift in the South African income tax system from source-based to residence based. Their reasoning was that an

increasing amount of income was beginning to flow into the country without being taxed. However, the recommendation of a residence-based tax system was rejected on the basis of the perceived complexity of implementing such a system.

The Margo Commission replaced the Franszen Commission during a trying economic period whereby international sanctions had been placed on the economy, there was massive business disinvestment, fiscal government was facing a debt standstill, monetary authorities were faced with historically high levels of inflation, the country was experiencing increasing human capital flight and the world economy was generally in a deteriorating state (Black et. al., 2005). In face of these economic challenges, the Margo Commission was appointed to restructure the tax system by particularly broadening the base on both direct and indirect taxes. Between 1987 and 1994 the commission implemented a number of key reforms on direct and indirect taxes. Reforms on direct taxes included i) the enhancement of neutrality in personal income tax by allowing equal treatment of both genders, ii) the reduction in company tax to a 35 percent, and iii) the introduction of a secondary tax on companies as a tax on distributed profits. On the other hand, reforms on indirect taxes included i) the replacement of the GST in favour of the invoice-based value-added tax (VAT) and ii) the introduction of the capital transfer tax as a replacement of the estate duty and donations tax. Despite these reforms, the share of individual taxation as a share of tax revenue increased from 32 to 40 percent between 1987 and 1994 whereas the share of company tax in total revenue had reduced from 22 to 13 percent over the same period of time. This was accompanied with negative economic growth rate averages of -0.7 percent experienced during the 1989 to 1993 period.

Following the transition of the South African economy into a democratic republic in 1994, the Government of National Unity implemented the Reconstruction and Development Programme (RDP) and it's offspring the Growth Employment and Redistribution (GEAR) policy as a means of correcting the social ills and imbalances suffered by disadvantages groups under the Apartheid regime. Part of the objectives of these policy programmes included the reduction of individual and corporate taxes while maintaining a stable tax-to-GDP ratio of 25 percent. On this basis the Katz Commission was appointed and assigned the responsibility of broadening the tax base, reducing fiscal borrowing pressures, improving tax base neutrality, improving tax administration and revenue collection all with the overall aim of improving economic performance (Koch et. al., 2005). Between 1994 and 1999, the Katz Commission released 9 interim reports and based on the recommendations of the commission the following

tax reforms were implemented. These reforms included the introduction of the capital gains tax, tax on interest and other income of the retirement fund industry and VAT on gambling and financial services, as well as the change from a source-based income to a residence-based one (Greyling et. al., 2008). However, the most important reform instituted under the Katz Commission was the establishment of the South African Revenue Services (SARS) as an independent government department. This institutionalization of SARS as an autonomous revenue collection agency greatly enhanced administrative efficiency as well as revenue-generating capacity (Bonga-Bonga and Perold, 2014). However, whilst job opportunities, lower inequality and improved investment were not achieved between 1994 and 1999 as part of GEAR outcomes, the economic growth rate increased from it's negative base in 1990 to more than 4.1 percent in 2000 (Schoeman and van Heerden, 2009).

Between 2000 and 2007, fiscal authorities had managed to reduce the share of individual taxation as a proportion of tax revenue from 42 percent to 30 percent whereas the share of company tax in total revenue had increased from 16 to 29 percent over the same period. This was accompanied with improving fiscal budget and economic growth even though such growth is unlikely to have been spurred by supply-side benefits associated with governments' improved fiscal position (Koch et. al., 2005). Moreover, the GEAR policy programme was phased out and ultimately replaced with Accelerated and Shared Growth Initiative for South Africa (ASGISA) programme in 2005, which envisioned halving unemployment to less than 14 percent and attaining economic growth rate averages of 6 percent between 2010 and 2014. However, the sub-prime crisis of the US housing market in 2007 and the subsequent global recession period of 2009, brought about a decrease in economic growth, a decrease in total tax revenue collection and increased budget deficits, amongst a host of other adverse economic. In wake of these developments, the South African government has adopted three interrelated policy programmes; the National Development Plan, the New Growth Path (NGP) and the Industrial Policy Action Plan (IPAP), in hope of encouraging economic development through improved job sustainability and the eradication of inequality by the year 2030. The Ministry of Finance particularly appointed the Davis Tax Committee in 2013 to access the compatibility of the South Africa's tax policy in supporting the objectives of the policy programmes and a major part of the committee's mandate is to limit government expenditure and boost revenue collection through tax reforms in order to fund key policy objectives such as infrastructure development (Phiri, 2016).

3 Methodology of the study

3.1 Scully's tax optimizing growth model

As previously mentioned, the theoretical model adopted in the paper is based on the optimizing model of Scully (1995, 1996, 2000 and 2003). The model particular assumes a balance budget approach in which government expenditure (G) is financed by the collection of tax revenue, τY (i.e. G = τY), where τ is the flat tax rate and Y is the national level of income. The remaining share of output, (1 – τ)Y, is used is used to produce goods and services for the private sector. It is assumed that both public and private goods are used to produce national output through the following constant returns endogenous Cobb Douglas production technology:

$$Y_t/Y_{t-1} = 1 + g = \alpha(\tau_{t-1}Y_{t-1})^{\beta}(1-\tau)^{\delta}(Y_{t-1})^{\delta-1} \quad (1)$$

Where the subscript t-1 denotes the previous periods and g represents the output growth rate. By log-linearizing equation (1) results in the following empirical regression used to estimation purposes:

$$log(1+g) = log\ \alpha + \beta\, log\, \tau(Y_{t-1}) + \delta\, log\ [(1-\tau)\ (Y_{t-1})] \quad (2)$$

Where the term 'log' denotes the logarithmic transformation of the time series. In order to obtain the optimal tax rate which maximizes economic growth, equation (2) is differentiated with respect to the tax rate and setting the answer to zero i.e.

$$\partial\ log\ (1+g)/\partial\,\tau = \beta\alpha\tau^{-1} + [\delta(1-\tau)^{-1}(-1) = 0 \quad (3)$$

And re-arranging equation (3) we obtain:

$$\beta/\tau = \delta/1-\tau \quad (4)$$

Whereas solving equation (4) for the optimal tax rate, τ*, yields:

$$\tau* = {}^{\beta}/_{\beta+\delta} \quad (5)$$

Despite the simplicity of the model in deriving the optimal tax rate, Kennedy (2000) criticized this framework since it is an endogenous growth model which ignores the contribution of previous periods' capital goods to output. In other words, the argument points out that Scully's model requires a 100 percent depreciation rate on the capital stock seeing that capital is assumed to be entirely used up in the processes of annual production. In reality this condition could never hold. However, Scully (2000) was quick to respond to these criticisms by demonstrating that the contribution of previously-accumulated capital and technological change in the aggregate production function are implicitly captured by the presence of the lagged production term. He particularly does this by showing that including factor inputs in the production function will not change the optimal tax rate estimates. Henceforth Scully (2000) was able to defend the efficiency and integrity of the tax optimizing model against criticisms set forth by Kennedy (2000).

3.2 The ARDL cointegration model

We use the ARDL framework of Pesaran et. al. (2001) to model cointegration relations within the log-linearized version of Scully's tax optimizing regression (i.e. equation (2)) and the quadratic variant of the model (i.e. equation (6)). The baseline ARDL specification for the log-linear regression (2) is given as:

$$\begin{aligned} \Delta log\ rgdp_t = \phi_0 + T_0 + \sum_{i=0}^{n} \gamma_{1i}\, \Delta log \frac{tax}{gdp}_{t-i} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta log \frac{priv}{gdp}_{t-i} \\ + \sum_{i=0}^{n} \gamma_{3i}\, \Delta log\ rgdp_{t-i} + \sigma_1 log\ tax/gdp_{t-1} + \sigma_2 log\ priv/gdp_{1t} + \\ + \sigma_3 log\ rgdp_{1t} + \varepsilon_t \end{aligned} \quad (8)$$

Where ϕ_0 and T_0 are the drift and trend components, respectively, γ_1, γ_2 and γ_3 are the short-run coefficients; σ_1, σ_2 and σ_3 are the long-run coefficients and ε_t is a well behaved error term. The first step in the modelling process is to test for cointegration effects. Pesaran et. al. (2001) suggest testing the null hypothesis of no cointegration as:

H_0: $\sigma_1 = \sigma_2 = \sigma_3 = \sigma_3 = 0$ (9)

And this null is tested against the alternative hypothesis of cointegration effects i.e.

H_1: $\sigma_1 \neq \sigma_2 \neq \sigma_3 \neq \sigma_3 \neq 0$ (10)

The aforementioned hypotheses are tested using a F-test which is validated against lower and upper bound critical values (Pesaran et. al., 2001). Only if the F-statistic exceeds the upper bound of the critical values can the econometrician proceed to model error correction effects within the system of equations. The ARDL based unrestricted error correction model (UECM) of equation (8) is given as:

$$\Delta log\ rgdp_t = \phi_0 + T_0 + \sum_{i=0}^{n} \gamma_{1i}\, \Delta log \frac{tax}{gdp}_{t-i} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta log \frac{priv}{gdp}_{t-i} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta log\ rgdp_{t-i} + \xi_1 ect_{t-1} + \varepsilon_t \quad (11)$$

Where ect_{t-1} is the error correction term that estimates the speed at which the variables return to their steady-state after an episode of disequilibrium to the system. The error correction terms is expected to be negative and significant. Moreover, it's value should not exceed unity.

4 Data and empirical results

4.1 Data description and unit root tests

The data used to carry out our empirical analysis consists of a quarterly series of two time series variables; namely, the real gross domestic product (rgdp) which proxies output growth and the ratio of tax revenues to GDP (tax/gdp) which is used to proxy the tax rate. The share of output used in the private sector (priv/gdp) is computed as the remnant portion of the share in output growth after deducting tax revenues i.e. priv/gdp = (1 – tax/gdp). All the time series data used in the study has been retrieved from the South African Reserve Bank (SARB) online database over the period 1994:Q1 to 2016:Q2. As previously discussed, we split the data into two sub-samples; the first being covering the period 1994:Q1 to 2009:Q2 being representative of tax policy under the Katz Commission whilst the second sub-period covers 2009:Q2 to 2016:Q4. However, before making an meaningful use of the data, we firstly tests

the data for unit roots using a combination of first and second generation unit root testing procedures. Traditionally, the ADF and PP testing procedures are used for detecting the presence of possible stochastic trends in the time series variables but these unit root are commonly criticized on the premise of not being able to distinguish between unit root processes and close-to-unit root process. Consequentially, we supplement these tests with the DF-GLS unit root test of Elliot et. al. (1996) which is essentially an improvement over these first generation unit root tests by exerting a higher testing power when the root of the time series is close to unity. We perform all three unit root testing procedure on the levels and, were necessary, on the first differences of the time series variables for three time periods i.e. 1994:Q1-2016:Q2; 1994:Q1-2009:Q2 and 2009:Q2-2016:Q2. The results of this empirical exercise are reported in Table 1 below.

Table 1: Unit root tests results

time series	adf		pp		df-gls	
	intercept	trend	intercept	trend	intercept	trend
1994:Q1-2016:Q2						
log(rgdp)	-3.65***	-3.77**	-43.37***	-46.01***	-2.62***	-3.13**
log(tax/gdp)	-6.55***	-8.58***	-69.90***	-78.26***	-6.47***	-8.25***
log(priv/gdp)	-6.53***	-8.54***	-67.21***	-76.64***	-6.38***	-8.30***
1994:Q1-2008:Q2						
log(rgdp)	-2.81*	-3.24*	-29.59***	-34.13***	-1.74*	-3.13**
log(tax/gdp)	-4.64***	-6.02***	-51.86***	-58.72***	-4.69***	-5.73***
log(priv/gdp)	-4.45***	-5.73***	-49.88***	-58.00***	-4.49***	-5.51***
2008:Q2 – 2016:Q2						
log(rgdp)	-2.57 (-4.12)***	-2.80 (-4.10)**	-17.84***	-18.06***	-2.57**	-2.63*
log(tax/gdp)	-6.40***	-7.83***	-23.50***	-23.18***	-6.35***	-7.57***
log(priv/gdp)	-6.33***	-7.58***	-23.91***	-23.72***	-6.35***	-7.44***

Notes: Significance levels: '***', '**', '*' denote the 1%, 5% and 10% significance levels respectively.

The unit roots test results, regardless of whether performed with a constant or a trend, show that for the full sample (i.e. 1994:Q1-2016:Q2) and the first sub-sample (i.e. 2008:Q2-2016:Q2) the test statistics reject the null hypothesis of a unit root at a significance level of at least 10 percent for all the observed time series. Collectively, these results show that all variables, in the full and first sub-sample, are levels stationary, I(0) processes. However, for the second sub-sample (i.e. 2008:Q2-2016:Q2), our results become mixed. We particularly find that whilst all unit root test statistics reject the unit root null for the tax/gdp and priv/gdp variables at all levels of significance, for the case of the rgdp time series, the ADF statistics fail to reject the unit root null at all significance levels. Only after differencing the series once do the ADF statistics fail to detect unit roots in the variables. This provides evidence of the rgdp variable being an I(1) time series. Under the traditional Engle-Granger theorem none of the sub-samples would qualify for cointegration since the full and first sub-sample strictly consists of I(0) variables whilst the second sub-sample contains a mixture of I(0) and I(1) time series. Fortunately, none of this is not much of a concern in our study, since the ARDL presents the advantage of being able to model cointegration relations between a mixture of time series which are integrated of an order less than I(2). Hence we model cointegration relations among the observed time series.

4.2 ARDL cointegration results

Having tested for units root among the time series and confirming that the variables are not integrated of an order higher than one, we proceed to apply the bounds cointegrationn test to the variable. The Schwarz-Bayesian (SBC) was employed to determine the appropriate lag length for the three period samples under observation. For all samples the appropriate model is the ARDL(1,0,0) specification. Table 1 below presents the cointegration tests results for the three period samples.

Table 2: Bounds test results for cointegration effects

	F-statistic	95% upper bound	95% lower bound	90% upper bound	90% lower bound
1994:Q1-2016:Q2	9.11	5.06	6.09	4.26	5.21
1994:Q1-2008:Q2	6.96	5.16	6.28	4.34	5.31
2008:Q2 – 2016:Q2	5.63	5.56	6.63	4.58	5.54

Based on the F-statistics we find cointegration relations between the time series for all three sub-samples. In particular, we obtain F-statistics of 9.11 and 6.96 for the full and first samples, respectively, and both these statistics are above the 95 percent upper bound. Concerning the second sub-sample we report a F-statistic of 5.63 which lies between the upper and lower bound of the 95 percent critical level. By default this means that the statistic is inconclusive at the 95 significance level. However, we observe that the statistic lies above the 90 percent upper bound hence validating cointegration at a 90 percent critical level. The overall confirmation of significant cointegration effects among the time series for all sample periods permits the estimation of the ARDL (1,0,0) regression and the modelling of the associated error correction effects. For empirical convenience, we begin by estimating the long-run ARDL coefficients for all sample periods and we reported the results in Table 3 below.

Table 3: ARDL (1,0,0) Long-run regression coefficients

	estimate	standard error	t-value	p-value
1994:Q1-2016:Q2				
intercept	-93.82	79.33	-1.18	0.24
trend	0.00	0.00	-0.93	0.36
log(tax/gdp)	11.96	10.62	1.12	0.26
log(priv/gdp)	41.26	34.23	1.20	0.23
R^2	0.34	-	-	-
DW	1.92	-	-	-
τ^*	22.47%/(N/A)	-	-	-
1994:Q1-2008:Q2				
intercept	82.21	88.31	0.93	0.36
trend	0.00	0.00	1.46	0.15
log(tax/gdp)	-11.20	0.01	1.46	0.33
log(priv/gdp)	-35.44	11.43	-0.98	0.36
R^2	0.37	-	-	-
DW	1.87	-	-	-
τ^*	N/A	-	-	-
2008:Q2 – 2016:Q2				
intercept	-551.39	21.846	-2.52	0.02*
trend	-0.01	0.01	-0.76	0.46
log(tax/gdp)	76.13	30.69	2.48	0.02*
log(priv/gdp)	237.52	93.71	2.53	0.01**
R^2	0.36			
DW	1.93			
τ^*	24.27%			

Notes: Significance levels: '***", '**', '*' denote the 1%, 5% and 10% significance levels respectively. DW represents the test statistics from the Durbin Watson test and all three statistics detect no evidence of serial correlation in the regressions.

As can be observed from Table 3, the estimation of the first sub-period and the full sample produces negative and insignificant estimates on the coefficients of the 'tax/gdp' and 'priv/gdp' variables. We therefore cannot calculate an optimal tax rate for these two sample periods since Scully's model specifically requires that regression coefficients must be both positive and significant in order to have an optimal point. Interpretively, this shows that tax policy administered under the Katz Tax Commission had an insignificant effect on economic growth from the time of the democratic elections liberation in 1994 up until the global recession period of 2008. For the case of the data for the first sub-period and the full sample, we find correct positive and significant coefficients on the 'tax/gdp' and 'priv/gdp' variables. From these estimates we are able to compute the optimal tax rates of 22.47 for the full sample and 24.27 percent for the second sub-sample. We note that both of these figures are quite different

from the optimal tax rates of 15 and 18 percent previously presented in the studies of Saibu (2015) and Schoeman and van Heerden (2009), respectively. We attribute these discrepancies in optimal tax estimates to the exclusion of pre-Apartheid data in our study, which otherwise would have produced a downward bias in the estimated optimal tax rate since tax reforms in post-democracy period reflects the non-discriminatory nature of the new South Africa.

Having estimated the ARDL long-run regressions for the 3 sample periods, we now investigate short-run and long-run interrelationships by estimating the ARDL-based UECM models for the sample periods. The obtained results are recorded in Table 4. In referring to these results, we find insignificant short-run estimates for all short-run coefficients in the full and first sub-samples. However, for the second sub-sample we obtain positive and significant short-run estimates on both the 'tax/gdp' and 'priv/gdp' variables hence providing evidence of both short-run and long-run interrelations between taxes and economic growth for South Africa in the post-recession period. Similar short-run effects between taxes and economic growth have been documented in the studies of Tomljanovich (2004), Lee and Gordon (2005) and Ojede and Yamarik (2012). Concerning the error correction terms, we obtain negative and significant estimates of -0.49 for both the first and the full samples whilst obtaining a significant estimate of -0.60 for the second sample period. These estimates imply that in the post-recession period 60 percent of disequilibrium from the long-run steady state is corrected in every quarter whereas for the pre-recessionary period and the full sample, 49 percent of deviations from the steady state are corrected in each quarter. This demonstrates that equilibrium correcting behaviour in the post-recession period is much quicker in comparison to the other sample periods. Our results ultimately prove that tax policy in the post-recession period has been quite effective in ensuring that the share of tax revenues in economic growth has been moving along a steady-state growth path.

Table 4: ARDL-based ECM estimates

	estimate	standard error	t-value	p-value
1994:Q1-2016:Q2				
Δtrend	0.00	0.00	-0.93	0.36
Δlog(tax/gdp)	11.96	10.62	1.13	0.26
Δlog(priv/gdp)	41.26	34.43	1.20	0.23
ect $_{t-1}$	-0.49	0.09	-5.40	0.00***
R^2	0.26	-	-	-
DW	1.92	-	-	-
F-statistic	7.49	-	-	0.00***
1994:Q1-2008:Q2				
Δtrend	0.00	0.00	1.46	0.15
Δlog(tax/gdp)	-11.20	11.43	-0.98	0.33
Δlog(priv/gdp)	-35.44	38.60	-0.92	0.36
ect $_{t-1}$	-0.49	0.12	-4.20	0.00***
R^2	0.29	-	-	-
DW	1.90	-	-	-
F-statistic	5.29	-	-	0.00***
2008:Q2 – 2016:Q2				
Δtrend	-0.01	0.01	-0.76	0.46
Δlog(tax/gdp)	76.13	30.69	2.48	0.02*
Δlog(priv/gdp)	237.52	93.71	2.53	0.01**
ect $_{t-1}$	-0.60	0.16	-3.72	0.00***
R^2	0.44	-	-	-
DW	1.93	-	-	-
F-statistic	5.17	-	-	0.00***

Notes: Significance levels: '***", '**', '*' denote the 1%, 5% and 10% significance levels respectively. DW represents the test statistics from the Durbin Watson test and all three statistics detect no evidence of serial correlation in the regressions.

As a final step in our empirical analysis, we check the residuals from all estimated ARDL regressions for autocorrelation, functionality and normality. All performed diagnostic tests are administered through the LM-type statistics and the results of the tests are reported in Table 5 below. As can be observed from the diagnostic test results, all the residuals from the estimated regressions for the 3 sample periods show no signs of serial correlation and are found to be stable as well as normally distributed. As noted by Schoeman and van Heerden (2009), such results satisfy the assumptions of the classical normal linear regression.

Table 5: Diagnostic tests on ARDL regression residuals

test type	LM test statistic		
	1994:Q1-2016:Q2	1994:Q1-2008:Q2	2008:Q2 – 2016:Q2
autocorrelation	7.34	14.44	0.01
	(0.84)	(0.27)	(0.92)
functional form	0.04	0.98	0.31
	(0.84)	(0.32)	(0.58)
normality	3.94	0.30	0.17
	(0.14)	(0.86)	(0.68)

Notes: p-values reported in parentheses.

5 Conclusion

Following the democratic elections of 1994, the South African government has been burdened with the responsibility of eradicating the lingering social ills of the previous Apartheid regime through increased government spending and this has been accompanied with need for increased collection of tax revenue. Further adding to government's woes has been the recent global recession period of 2009 which saw economies worldwide experience sharp declines in economic growth rates and fiscal authorities have been once again delegated the responsibility of ensuring that economic growth returns to a positive long-run equilibrium steady state path in the post-recession period. Conventional tax-growth theory hypothesizes on a positive tax-growth relationship up to a certain optimal level of which this relationship turns negative afterwards. In our study we put this theory to the test for the case of South Africa by applying the ARDL bounds test approach of Pesaran et. al. (2001) to the tax optimizing growth model of Scully (1996, 2003) for sample time periods before and after the global recession period. Our empirical results reveal a non-existent relationship between tax revenue and economic growth for periods prior to the recession whereas this relationship turns significant in the post-recession period.

Overall, the empirical results from our study reveal a number of interesting phenomenon. For one, the insignificant relationship found between tax revenue and economic growth in the pre-recession period highlights the ineffectiveness of tax policy on economic growth under the Katz Tax Commission. In particular, our empirical results demonstrate the incompatibility of previous tax policy with three former macroeconomic policy programmes (i.e. the Reconstruction and Development Programme (RDP) and it's predecessors the Growth Employment and Redistribution (GEAR) and Accelerated Shared Growth Initiative of South

Africa (ASGISA) policies) in promoting economic growth in the country. The overall effectiveness of fiscal policy in affecting economic growth under these macroeconomic programmes are a reflection of poor policy co-ordination and implementation methods used. Another implication drawn from our study is that fiscal policy implemented subsequent to the global recession period has exerted a positive effect on economic growth and this is mainly attributed to the successful recommendations of the Davies Tax Committee in keeping revenue collections on par with the long-term economic growth objectives as outlined in the recently adopted New Growth Path (NGP) programme. As a natural development to this study, future research should focus on determining the optimal tax structure for South African tax authorities under the Davies Tax Committee administration.

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